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PORTABLE PUMPING SYSTEM

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A portable pumping system was developed for use by military units to control crowds in a civil disturbance situation. The system is a skid-mounted self-contained unit which can be transported by and used on a 2 1/2-ton military cargo truck, and which can also operate independent of the truck. The water stream is effective for controlling/dispersing personnel at ranges up to 75-80 feet. The system was developed from commercial components in order to provide a capability within a short time frame. A special motor-driven		

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ball valve was developed to automatically and continuously pulse the water stream as an optional mode of operation to conserve the water supply. Brief acceptance tests were conducted to verify system performance. The system met the required specifications, and the pulsed water stream was effective.

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INTRODUCTION

One of the Problems which confront Military Police and National Guard units when they are assigned a civil disturbance mission is the control or dispersal of a crowd by less-than-lethal means.

In response to this requirement, the Military Police School (formerly the Military Police Agency) drafted a requirements statement for a water pumping system, which - by use of commercially available components - would provide a capability within a short-term and low-cost development program. Because there has been some experience with the employment of water in civil disturbance situations, the use of a water stream system was considered to be an acceptable method of crowd control.

The Portable Pumping System was developed under contract by the FMC Corp., John Bean Division, Tipton, Indiana.

DESIGN REQUIREMENTS

The Portable Pumping System was designed to meet the performance and physical characteristics of the requirements statement, which are summarized as follows:

- a. Effective Range. The water stream shall deter a person from approaching closer than 75 feet without serious injury or lethal effect, and have a 360° field of fire.
- b. The system shall be a skid-mounted self-contained unit.
- c. The system shall mount on and operate from the bed of standard military tactical 2 1/2-ton trucks (M35, M36 and M211); and also be capable of operating off the truck as a self-contained unit.
- d. The system shall have the capability of introducing a chemical riot control agent into the water stream.
- e. The self-contained water tank capacity shall be a minimum of 750 gallons of water. The system shall have an effective continuous stream endurance of at least five minutes, and the powerplant shall have the capability of self-contained operation for four hours.
- f. The force of the water stream shall be variable - without interruption of operation - to permit engagement of target personnel at close range without lethal/injurious effect.
- g. The self-contained water tank shall be capable of being filled from a static water source (stream, pond, or container), or a fire hydrant. The system also shall be capable of operating while drawing water directly and continuously from a fire hydrant.

DESCRIPTION

Components

The Portable Pumping System consists essentially of a commercially available skid-mounted gasoline-engine-driven fire fighting pump unit. (See Figures 1 and 2.) It is equipped with a deluge nozzle and an 800-gallon water tank. A description of each component follows:

Engine-Pump Unit

The skid-mounted pump unit is a Hale Fire Pump Company Model 30FS-F250. It is capable of pumping up to 300 gallons per minute at 340 psi pressure. The pump is driven by a 250 cubic-inch displacement gasoline-fueled engine which has a 138 horsepower rating at 3400 revolutions per minute. Total weight of the skid-mounted engine-pump unit is 1300 pounds.

Deluge Nozzle and Platform

A raised platform of 1/8-inch thick diamond pattern steel plate deck is mounted above the engine-pump unit for the operator to stand on. The deluge gun (nozzle) is an Elkhart Model No. 292-6 with 360-degree horizontal rotation and 90-degree vertical elevation. Control of flow through the nozzle is by a special motor-driven ball valve with an automatic variable cycle on-off or manual control.

Water Storage Tank and Piping

The 800 gallon water storage tank is constructed of copper-bearing 12 gage steel. It is of welded construction with interior baffles to prevent water surge. The tank is equipped with a sump to permit maximum use of the water before refilling. The pump, tank, and deluge gun are piped to permit refilling from a pond or from a hydrant. A by-pass valve and line is incorporated in the system to prevent over heating of the pump during periods when the pump is running but the nozzle valve is closed.

Skid Frame

The entire self-contained system - consisting of water tank, pump, engine, platform, deluge gun and piping - is mounted on a skid-frame. Suitable lifting eyes and a lifting sling are provided for loading and unloading the system onto and from the load-bed of a 2 1/2-ton truck. The empty system weight is 3100 pounds. Filled with water, the system weight is 9800 pounds.



Figure 1. Portable Pumping System

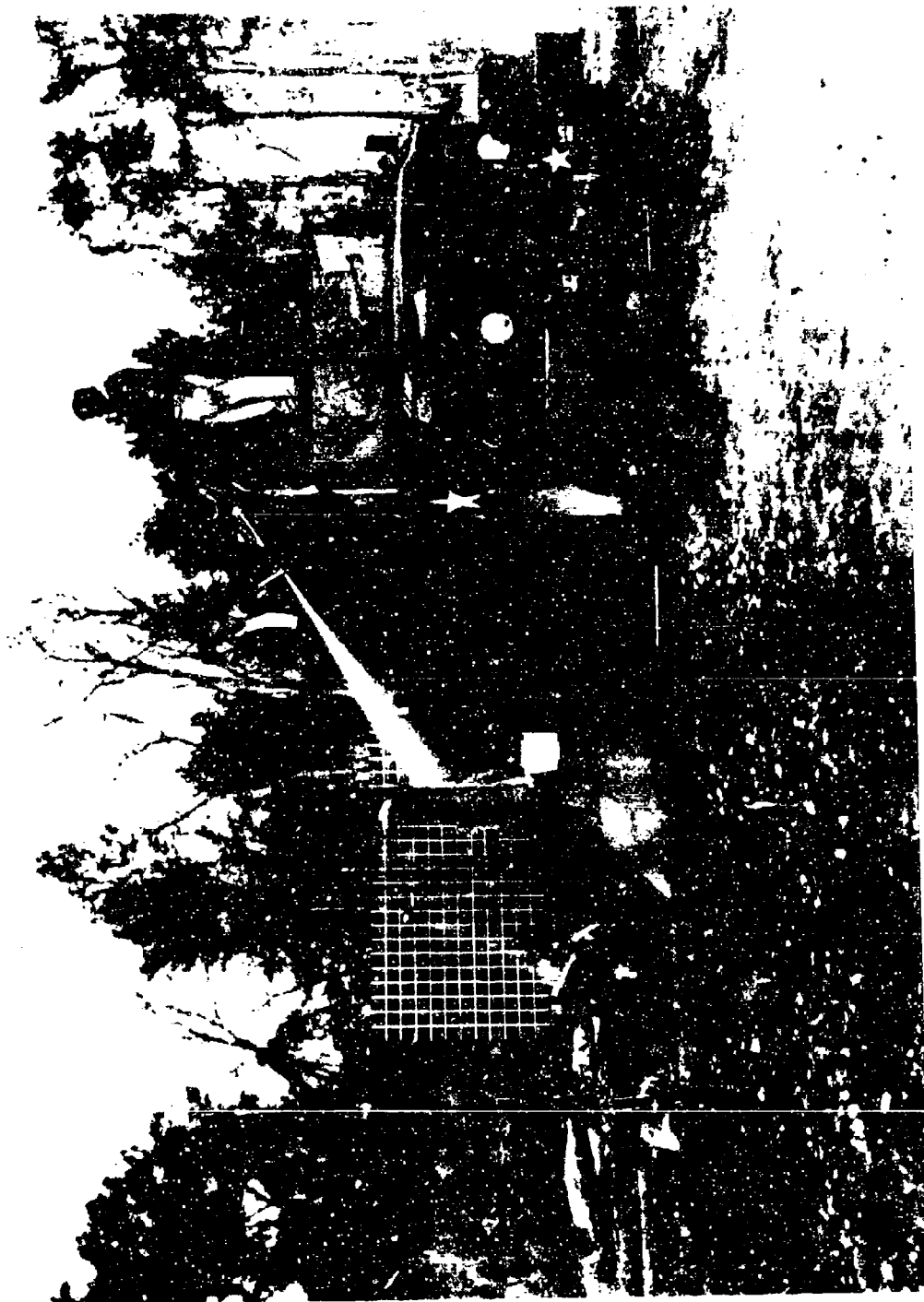


Figure 2. Portable Pumping System, Truck Mounted

DEVELOPMENT AND TESTS

Development

The system was designed to meet the required characteristics using commercial components where possible. It was thought that meeting the 5 minute effective continuous stream capability without exhausting the 800-gallon tank capacity required a special approach. The use of an intermittent water stream was considered as a means to conserve the water supply, while not affecting the required crowd control effectiveness. A special motor-driven ball valve (pulser) was developed to accomplish this. The electronic valve control, as designed, permitted a variable open-close cycle so that the optimum pulse condition could be determined by test.

Tests

Acceptance tests were conducted to verify system performance. The tests to determine the effective range for controlling/dispersing personnel were conducted by employing the water stream against volunteer project personnel. The target personnel approached towards the water nozzle while being barraged with the water stream. The maximum effective range was the range at which the subject was either physically unable to advance closer towards the water stream because of its force, or was unwilling to advance further because of pain or fear of injury.

The required performance specifications and physical characteristics of the requirement were met.

Steady Stream Flow

The test results with a steady stream are summarized in Table No. 1. The 5/8" nozzle with a continuous flow rate of 158 gallons per minute is capable of holding back a 200-pound man at ranges in excess of 75 feet. At the "stopping distance" range the subject had difficulty advancing or maintaining balance, was being bruised, and was preoccupied with protecting his head and eyes.

Intermittent Stream Flow

The tests were repeated using an intermittent stream of water. The tests were conducted with several on-off cycle durations. The minimum effective pulse duration is limited by the opening-closing time of the valve. The results of the intermittent flow tests are summarized in Table No. 2. The 5/8" nozzle with intermittent flow and an average flow rate of 75 to 100 gallons per minute is capable of holding back a 200-pound man at ranges in excess of 75 feet. Thus, the intermittent water stream extends the engagement time from 5 to 8 minutes. Test subjects expressed the opinion that the intermittent stream flow was a more effective deterrent than the continuous water stream. The one-inch nozzle size produced greater range effectiveness, but at a higher water consumption rate.

TABLE NO. 1: Summary of Tests - Continuous Stream Flow.

Nozzle Size (Inches)	Nozzle Pressure (psi)	Flow Rate (GPM)	Stopping* Distance (ft.)
1/2	96	72	39-45
1/2	135	85	54-60
1/2	190	100	56-59
5/8	160	146	75
5/8	190	158	80
1"	96	290	80
1"	44	195	55

*The closest approach that a 200-lb. man could make toward the deluge nozzle.

A more extensive testing program was conducted to relate measurable water stream parameters with physiological effectiveness. These tests are reported in the Reference*. This program also included tests of a cartridge-actuated pulsed water stream system.

*Ballistically Operated Water Cannon, Supplement to Final Report, Technical Report No. LWL-CR-04M72A, June 1974.

TABLE 2. SUMMARY TESTS - INTERMITTENT STREAM FLOW

Nozzle Diameter inches	Pressure PSI	GPN - From Flow Chart Based on Continuous Operation	Est. Actual GPN with Pulsing	Pulse Duration Seconds	Time Between Pulses	Remarks
5/8	150	141	56.5	0.2	0.5	Effective at 60 to 70 feet.
5/8	150	141	70.5	0.5	1.0	Effective at 65 to 75 feet.
5/8	150	141	70.5	1.0	2.0	Effective at 65 to 75 feet. Rioter may be able to throw missiles.
3/4	150	205	82.0	0.2	0.5	Effective at 70 to 80 feet - water slugs painful at 75 feet.
3/4	150	205	102.4	0.5	1.0	Effective 75 to 80 feet - water slugs painful at 80 feet.
3/4	150	205	02.4	1.0	2.0	No improvement, stream appeared to be unstable at continuous operation.
13/16	150	275	110	0.2	0.5	Effective at 70 to 80 feet. Stream was unstable-water red fuzzy-no pain felt.
13/16	150	272	137.5	0.5	1.0	Effective at 80 to 90 feet. Stream unstable - no pain.
5/8	175	152	60.7	0.2	0.5	Effective at 75 to 85 feet. Painful at 80 feet.
5/8	175	152	76	0.5	1.0	Effective at 75 to 85 feet. Nozzle appeared to be overloaded and arrested.
3/4	175	218	87.2	0.2	0.5	Effective at 80 to 90 feet.
3/4	175	218	109	0.5	1.0	Effective at 85 to 90 feet.
13/16	175	298	119.2	0.2	0.5	Effective at 90 to 95 feet.
13/16	175	298	149.0	0.5	1.0	Effective at 95 to 100 feet.

CONCLUSIONS

1. The Portable Pumping System is capable of providing a water stream for controlling/dispersing personnel in a civil disturbance situation, with an effective range of approximately 75-80 feet and a duration of eight minutes.

2. The performance characteristics of the requirements statement were met.